Maximizing Student International Experience Options Under Tight Resource Constraints

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Abstract *- All engineering graduates from Union College are required to complete the " Other Languages; Other Cultures; Other Disciplines" portion of the College General Education program. Students can meet this requirement through completing three courses in a mod ern language, completing a three course cultural diversity track (Africana, East Asian, or Latin American Studies), or participating in a variety of programs that require travel abroad. Approximately 8 8% of the engineering students at Union opt for actual international travel. The authors believe that Union is unique in having such a large percentage of its engineering students experiencing first hand the culture of another country. The international travel component can take several forms, including tradit ional terms abroad, engineering exchange programs, international internships in industry, mini -terms, or collaborative design projects. Some options require langu age proficiency; others do not. This paper will describe each of these options in some detail, then will present an analysis of how Union College is trying to maintain, and even expand, engineering student international program opportunities under tight budget con straints. To do this, Union is shifting emphasis from traditional terms abroad to more cost effective programs such as exchanges and international industrial internships. The present situation, a benefit/cost analysis, and future plans will be discussed.*

Index Terms *- Exchange programs, globalization, international study, student exchanges , terms abroad*

INTRODUCTION

Union College, located in Schenectady, NY, is a liberal arts institution with strong programs in engineering and computer science. Union was one of the first colleges in the country to offer a degree in engineering (Civil Engineering, 1845). Out of the total student population of slightly more than 2000, approximately 300, or 15%, are engineers and computer scientists. The target for growth is to increase the proportion to 20%. Union's academic calendar has three terms per year, each with ten weeks of classes followed by a week of exams. The engineering curricula at Union are designed so a student can be away during certain terms and still take all required courses to graduate on time.

This flexibility is necessary because all engineering graduates from Union College are required to have completed the "Other Languages; Other Cultures; Other Disciplines" portion of the College General Education program. This requirement can be met in several ways. The International Language Track requires any sequence of three courses in a classical or modern language. Students can either begin a new language or be placed at the appropriate level in a language studied in high school. If a student places into higher level language, only two courses are required. The Cultural Diversity Studies Track can be completed by taking three courses in Africana Studies, East Asian Studies, or Latin American Studies. These are each degree granting programs, so they are not mere assemblages of survey courses. Although the above two options do not require international travel, they at least introduce the student to other cultures. They also may be the only way for certain students to meet the requirements. Union requires that students have at least a 2.3 cumulative average to participate in a program requiring international travel. Also, some students have family or other commitments that make it difficult for them to travel abroad for an extended period.

OPTIONS REQUIRING INTERNATIONAL TRAVEL

All of the remaining options require some period of travel to another country. The International Study Track is any Union Term Abroad with associated prerequisites, or equivalent international study (Union allows a certain number of students to travel on non-Union. terms abroad each year). Union's International Programs office does everything it can to accommodate engineering students who want to take a term abroad. One problem is that some terms abroad have language prerequisites. Unless an engineering student has four years of a language in high school, it can be difficult for him or her to meet the prerequisites.

Also, Terms Abroad programs require substantial monetary commitment on the part of institutions. They are not self-supporting. Therefore, it is probably not realistic to expect to have enough terms abroad opportunities to accommodate all students.

Exchange programs with international engineering schools seem to be an ideal way of increasing the number of experiences available to engineering students. Since students are going in both directions, there is theoretically no net expense to either institution so long as the numbers are equal. Additionally, students don't have to worry about falling behind in their engineering studies, as they can take engineering courses at the host institution. However, there are limiting factors. Some international institutions offer all or a good percentage of their courses in English. Others offer only a few, or none, in English. There may be differences in curriculum, calendar, or grading systems that make it difficult to mesh with the average U.S. engineering curriculum. You also have to be concerned about the equivalency of courses, especially in the design area. Thorough documentation needs to be gathered to convince ABET program evaluators that the courses are indeed equivalent to those at the U.S. institution.

Mini-terms are shorter, intense immersions in another culture accompanied by further study at Union. A series of seminars are held the term before the international travel. These encompass cultural expectations, technical and social issues associated with the theme of the mini-term, and pre-travel logistics. Students are also required to take at least one additional academic course related to the culture studied in the mini-term. The time spent abroad is typically three weeks, and occurs during summer or intersession to avoid conflicts with regular classes. Mini-terms involve extensive touring around the host country to compliment the theme of the mini-term. The student group for a mini-term is half engineers and half liberal arts students. Interdisciplinary teams complete a comprehensive report on a topic related to the mini-term. Union has received several grants to help develop and run mini-terms.

To date interdisciplinary mini-terms have been conducted in Australia, New Zealand, Brazil, Scotland, and Spain. Two of the mini-terms illustrate the diversity of themes that have been developed. In New Zealand, the mini-term studied the technology and economics of power generation, transmission, and retailing. New Zealand has a unique mix of hydroelectric, geothermal, wind, and both traditional and advanced thermal power production. They have also recently deregulated their electricity markets, similar to what has taken place in the U.S. All of this, plus the fact that New Zealand is a beautiful country, made for a very successful mini-term. An equally successful, but altogether different mini-term was conducted in Southern Spain. Its theme was the technology and cultural issues that made Cordoba the cultural capital of Europe in 1000 AD. Visits to Roman ruins, antiquities museums, and archeological sites not yet open to the public provided a rich background for the students in their projects.

In the International Virtual Design Studio (IVDS), students interact over the Internet with students at an international university on a cooperative design project. The project culminates in travel to the international institution for a design competition. In some instances groups from the international institution also travel to the U.S. To date the only significant IVDS program is with the Middle East Technical Institute in Ankara, Turkey. However, faculty are being encouraged to develop other IVDS programs, and the first author is working actively with universities in Germany, France, Spain, and Mexico to develop additional IVDS projects.

Union students can also receive international experience credit for an international term in industry. Depending on the length of the internship, the student may have to take at least one academic course at Union pertaining to the culture of the host country. International internship opportunities are limited, although Union is working to increase the number available to students.

Table I gives the percentage breakdown of international experiences among the various categories for the class of 2003, and for the last four classes. The data show that over the last five years approximately 88% of the engineering students at Union went abroad for some type of international experience.

Type of Experience	2004	Five Year Average
Regular Term Abroad	13%	19.7%
Exchange	39%	31.1%
Mini-term	28%	31.5%
IVDS	2%	4.2%
International Term in Industry		1.2%
Other (Not involving international travel)	18%	12.3%

TABLE 1
ENGINEERING STUDENTS' INTERNATIONAL EXPERIENCES

The low relative ranking of regular terms abroad is not because of a lack of opportunities. It can be at least partially attributed to the language requirements of several of the terms. Unfortunately, U.S. secondary schools do not give language instruction a high priority. In a recent study, only 33.6% of the incoming freshmen engineers at Union had four or more years of language instruction in high school (23.0% Spanish, 6.2% French, 2.2% German, and 2.2% other). A full 14.6% had no language background at all, and the remaining 51.8% had between one and three years of instruction [1]. Language study at the college level is very demanding, and engineers as a group seem to think they are less skilled at language learning than other students, or at least they do not want to invest the time necessary to gain language proficiency. Therefore, many engineering students shy away from terms abroad that require language proficiency. Efforts are now underway at Union to encourage more engineering students to study modern languages during their college years.

Exchanges are the largest component of the international experiences. Further investigation shows that most of the exchanges result from one program with the Czech Technical University in Prague. The Prague program is very popular because all of the classes are in English, and Prague is a delightful place to visit in the fall. However, this reveals vulnerability in the system that needs to be addressed.

PRESENT SITUATION

It is the goal of the engineering programs at Union to have sufficient number and variety of international experiences available to allow all students to participate in a program that is of interest to them and meshes with their professional and personal interests. In a period of fiscal belt tightening, it is unlikely that many additional terms abroad will be developed. In fact, Union is presently under a moratorium for developing any new terms abroad unless another term is eliminated. Due to a 5% reduction in the international programs budget and unfavorable exchange rates, the actual number of Union students participating in terms abroad has dropped from 345 to 275, a 20% decrease, over the last three years.

Mini-terms are certainly an option. However, they are highly dependent on faculty interest, as they have yet to be institutionalized in the manner of terms abroad. It is also unclear whether students and parents will be willing to shoulder the extra expense after the initial development grants run out. The Union administration has made it clear that the institution does not plan to subsidize mini-terms. That makes mini-terms attractive from the institutional perspective because of the negligible direct costs. There would still be some indirect costs, however, in the form of lost faculty time. There are also some influential faculty who refuse to recognize the academic rigor of mini-terms, although close examination shows the rigor is there.

IVDS projects are very consumptive of faculty time with little return other than personal satisfaction. Unless faculty are given teaching credit for IVDS projects, they will probably never contribute significantly to increasing international study opportunities.

Union College does not have a formal cooperative education program that places students in industrial internships. The Career Development Center does provide some support to students looking for internships, in the form of resume preparation and assistance with searches. To date, most international internships have been secured through family or personal contacts, or in the case of one student after he had done a domestic internship with a company that had international branches.

BENEFITS VS. COSTS FOR VARIOUS INTERNATIONAL EXPERIENCE OPPORTUNITIES

To help evaluate how best to maintain or increase the number of international experience opportunities for Union students, the authors undertook a benefit/cost type analysis for the various options requiring international travel [2]. In benefit/cost analysis, benefits (B) are defined as amounts that accrue to the constituencies involved in a project, like the value of hydroelectric power produced or the reduction in flood losses for a dam project. Costs (C) are both the capital costs and the equivalent costs for operation and maintenance. Disbenefits (D) are costs incurred by the constituencies as a result of the project, such as the loss of agricultural land or wildlife habitat because the dam was built. If the ratio (B-D)/C is greater than one, a project is an attractive investment. Analysts can generally estimate costs fairly accurately, but estimating benefits and disbenefits can be very difficult. For example, how would you estimate how many lives would be saved by a flood control project, and what is the value of each life saved? Reviewers of projects justified by benefit/cost analysis have to carefully examine the benefits to make sure they haven't been inflated to justify a marginal project.

In our case, the costs are the sum of direct costs (tuition, housing, etc.) and indirect costs (administrative overhead, faculty time, etc.). These are fairly easily quantified. However, the benefits and disbenefits of international experiences for students are much more difficult to quantify. Everyone agrees that students should be prepared to compete in the global engineering marketplace, but virtually no research has been done on how much more an engineer may earn during a lifetime if he or she has had an international study experience as an undergraduate, or how much more he or she may contribute to the

profession. Therefore, benefits and disbenefits will be identified and qualitatively assessed as to their probable impact on the professional development of the student engineer. The end product will be a ranking of the positive influence of different international experiences. The quantitative cost ranking and the qualitative benefits/disbenefits ranking can then be used together to help universities decide how best to invest scarce resources.

RELATIVE COSTS OF PROGRAMS

Table 2 shows comparative duration and cost data for the five programs used most frequently by Union engineering students to fulfill their international experience requirements.

Type of Experience	Duration (weeks)	Cost/Student	Cost/Student/Week
Regular Term Abroad	10	$8679	$868
Mini-term	3	$3750	$1250
Exchanges	10	$1840	$184
IVDS Internet Projects	1	$1440	$1440
International Internship in Industry	10	$7000	$700

TABLE 2
DURATION OF INTERNATIONAL TRAVEL AND COST OF INTERNATIONAL PROGRAMS AT UNION COLLEGE

Note that the durations given are the length of international travel, not necessarily the length of the program. For example, mini-terms have a series of seminars before the trip, and a post-trip comprehensive paper. Also, where appropriate the costs include administrative costs, and the equivalent cost of uncompensated faculty time. The data would suggest that exchanges have the most impact per dollar spent.

Theoretically, exchanges should involve no net cost to either institution, so long as the numbers of student participants are balanced between the institutions. However, some costs arise because of the differences in calendars between terms and semesters, and because of an extra allowance given to Union students for food while they are abroad.

International terms in industry costs are estimates, because Union College at this time does not have a formal structure for sending students on international internships. The students who have taken this avenue so far have made their own arrangements. If a more formalized structure is developed, the direct costs would still be negligible, but the indirect costs for a coordinator to develop internship opportunities could be quite large per student if the number of students going on terms in industry is small. The costs in the table are based on one mid-level administrator with fringe benefits, a travel budget, and an estimate of ten students per year going on international industrial internships.

PROGRAM BENEFITS AND DISBENEFITS

Regular Terms Abroad

Regular terms abroad provide at least ten weeks of living in the host country, with varying degrees of cultural immersion. A significant fraction of regular terms are held at special institutes set up specifically for terms abroad to avoid problems in calendar incompatibilities. Unless they live with families, the term abroad students may live together, eat and drink together, and go to class together. Thus, they may have little contact with students from the host country. On the plus side, they have a support group in the form of other Union students, and generally a Union faculty member to help them cope with cultural challenges they encounter. Terms abroad that require students to converse and work in the language of the host country are much more beneficial to students than terms abroad held entirely in English. U.S. Engineers who speak a second language have a distinct advantage in the international arena over those who do not [3]. A disbenefit of regular terms abroad, at least at Union, is the lack of opportunity to take engineering courses. Engineering students have to plan carefully, or the curriculum needs to be flexible enough to allow them to be away for a term and not fall behind in required engineering courses.

Mini-terms

Mini-terms provide the benefit that they allow students to get some international experience without having to deal with interruptions in their regular course sequence. Engineering students learn to work in interdisciplinary teams including liberal arts students, which is useful in the global marketplace. They also gain some exposure to international engineers.

Exchange Programs

Exchange programs have many features that contribute to their attractiveness. First of all, they have a strong engineering component, which many international educators and practitioners feel is important in developing the global engineering perspective needed by graduates [4]. Students will be able to take engineering courses that may substitute for required courses in the home institution curriculum, or may be credited as supplemental technical electives. Exchanges can be better cultural immersion experiences than regular terms abroad. Exchange students generally will not experience the same cultural isolation sometimes prevalent in terms abroad programs. They will be in smaller groups, or alone, and will be taking normal classes with the host country students. Exchange students are likely to interact with a broader spectrum of international students. Exchanges that make students speak and work in the host country language will provide the same benefits as terms abroad with language requirements, with the slight advantage that they will also be learning technical terms. Exchange programs have the additional advantage of bringing international students to the Union campus. Thus Union students will have continuous interactions with students from other cultures. A disbenefit of exchange programs is the lack of an effective support group because of the small number of students being exchanged in most cases, and no accompanying faculty.

IVDS

IVDS projects give students a valuable introduction to design involving different engineering cultures. Students will also interact with both international engineering students and professionals. However, technical difficulties in communicating may take away from their time for doing actual design.

International Internships in Industry

International internships in industry have many of the same benefits as exchanges, but provide greater interaction with international engineers and more thorough cultural immersion. Working in a company and living on the economy is about as good a cultural immersion as you could get. The main disbenefit is that generally there is no opportunity to take courses during the internship. Thus the student either has to take overloads to make up for the missed term, or graduate late.

NET BENEFITS

Table 3 shows the benefits and disbenefits for each of the international experience options available to Union College engineering undergraduates. The weighting factors represent the authors' opinions as to the relative impact on the professional development of the student for that particular benefit or disbenefit. The numeric values are based on a value of 1.0 assigned for living in an international culture for a minimum of ten weeks; the length of the Union academic term. The authors welcome input from others about the best weighting factors to use in refining the procedure.

Regular Term Abroad	Weighting
Benefits	
• Length of stay	1.0
• Language proficiency	3.0
• Cultural immersion	0.5
• Support group	0.2
Disbenefits	
• No engineering courses	-0.5
Net Benefits (with language)	4.2
Net Benefits (without language)	1.2

Mini-term	Weighting
Benefits	
• Length of stay	0.3
• Doesn't interfere with regular classes	0.3
• Interdisciplinary	0.4
• Interaction with international engineers	0.2
Disbenefits	
•	
Net Benefits	1.2

Engineering Exchanges	Weighting
Benefits	
• Length of stay	1.0
• Engineering classes	0.5
• Interaction with international engineers	1.0
• Cultural immersion	1.0
• Language proficiency	3.2
• International engineers at Union	0.3
Disbenefits	
• Lack of support group	-0.5
Net Benefits (with language)	6.5
Net Benefits (without language)	3.3

IVDS	Weighting
Benefits	
• Length of stay	0.1
• Interaction with international engineers	0.5
• Design oriented	0.5
Disbenefits	
• Technical difficulties	-0.2
Net Benefits	0.9

International Internship in Industry	Weighting
Benefits	
• Length of stay	1.0
• Interaction with international engineers	2.0
• Language proficiency	3.2
• Cultural immersion	1.5
Disbenefits	
• No academic credit	-1.0
Net Benefits (with language)	6.7
Net Benefits (without language)	3.5

TABLE 3
NET BENEFITS

RANKING OF PROGRAMS

Table 4 gives a comparative ranking of the costs for the five different kinds of international experiences available to Union College engineering students, along with the corresponding net benefits both with and without language requirements. For the costs, a ranking of one indicates the least expensive alternative.

Program	Cost/Student	Cost/Student/Week	Net Benefit (with language)	Net Benefit (without language)
Regular Term Abroad	5	3	4.2	1.2
Mini-term	3	4	1.2	1.2
Engineering Exchange	2	1	6.5	3.3
IVDS	1	5	0.9	0.9
International Internship in Industry	4	2	6.7	3.5

TABLE 4
RANKING OF PROGRAMS

FUTURE DEVELOPMENTS

The authors wish to emphasize that this benefit/cost methodology for evaluating the different forms of international experience for engineering students is a work in progress. The authors welcome input from those active in the field as to other suggested weightings for benefits, and comparative costs for programs at other institutions. With that in mind, the initial results show international internships and engineering exchanges to be excellent overall choices for international experiences, both from cost and from benefits standpoints. Although the weighting may change with further input from the field, it is also quite obvious that language proficiency is a very important part of any international experience, and is a valuable asset to any engineer.

It is the goal of the engineering programs at Union College to have sufficient number and variety of international experiences available to allow all students to participate in a program that is of interest to them and meshes with their professional and personal interests. In a period of fiscal belt tightening, it is unlikely that many additional terms abroad will be developed. In fact, Union is presently under a moratorium for developing any new terms abroad unless another term is eliminated. Mini-terms are certainly an option. However, they are highly dependent on faculty interest, as they have yet to be institutionalized in the manner of terms abroad. It is also unclear whether students and parents will be willing to shoulder the extra expense after the initial development grants run out. The Union administration has made it clear that the institution does not plan to subsidize mini-terms. That makes mini-terms attractive from the institutional perspective because of the negligible direct costs. There would still be some indirect costs, however, in the form of lost faculty time. There are also some influential faculty who refuse to recognize the academic rigor of mini-terms, although close examination shows the rigor is there. IVDS projects are very consumptive of faculty time with little return other than personal satisfaction. Unless faculty are given teaching credit for IVDS projects, they will probably never contribute significantly to increasing international study opportunities. That leaves exchanges or international terms in industry as the most likely vehicles to significantly increase the number of opportunities.

INTERNATIONAL INTERNSHIPS IN INDUSTRY

Although international internships ranked first in net benefits and second in cost per student/week, and share many of the same advantages cited for exchanges below, they will probably not contribute a significant number of international experiences for Union students in the foreseeable future. This is because Union does not have the administrative resources to coordinate the program, and does not plan to add new resources. The engineering programs and the international programs office will continue to do their best to help students take advantage of any opportunities that arise, but will not be actively seeking new partnerships. Hopefully when additional resources are available Union will put increased emphasis on developing additional international internship opportunities. In the meantime, other institutions may find the benefit/cost results useful in promoting international internship programs.

EXCHANGE PROGRAMS [5]

Union is now negotiating with universities where French, German, or Spanish is the native tongue to develop exchange programs that require anywhere from minimal to high language proficiency.

Issues Favoring Exchanges

Exchange programs have many features that contribute to their attractiveness. First of all, they have a strong engineering component, which many international educators and practitioners feel is important in developing the global engineering perspective needed by graduates (GAIN 2002). Students will be able to take engineering courses which may substitute for required courses in the home institution curriculum, or may be supplemental technical electives.

Exchanges can be better cultural immersion experiences than regular terms abroad. A significant fraction of regular terms are held at special institutes set up specifically for terms abroad to avoid problems in calendar incompatibilities. The term abroad students may live together, eat and drink together, and go to class together. They may have little contact with students from the host countries. Exchange students generally will not experience the same cultural isolation. They will be in smaller groups, or alone, and will be taking normal classes with the host country students. Exchange students are likely to interact with a broader spectrum of international students. Exchange programs have the additional advantage of bringing international students to the Union campus. Thus Union students will have continuous interactions with students from other cultures.

When exchanges are balanced, it minimizes the cost to both institutions. Furthermore, exchanges may lead to further collaborations, including faculty exchanges for research or teaching, and collaborative design or research projects involving students of both institutions.

Types of Exchanges

The classical type of exchange is a one for one exchange of students for a semester or a whole year. If both institutions provide student housing, the exchange agreement can cover tuition, room, and board. The student would just pay the normal fees to the home institution. In instances where universities do not have housing, or the housing is run by an independent agency, exchanges are usually tuition only, and the students are responsible for paying for room and board, although the receiving institution should still be responsible for arranging housing.

There are many variations on this theme. Differences in calendars, or other factors, may make it desirable to send X students abroad for the whole year, and receive 2X in return for one semester. Another possibility is a half year exchange followed by a half year industrial internship. Even industrial internships alone can be exchanges. For example, a multinational company could send U.S. students to one of their branches in another country, and receive students from the other country for internships in their U.S. plant. This would be an excellent way for companies to identify potential future employees with a global perspective, who would also be very familiar with the company's international branches. For universities that are so equipped, students might be able to take one or more courses from the home institution through distance learning facilities during the exchange or internship.

Other shorter term exchanges include the IVDS or Internet design projects; summer research projects; or multicultural/multi-university summer programs for public service projects or technical/cultural/industrial orientation visits. These would all provide an international experience without missing classes at the home university, and would solve many of the calendar conflicts between institutions.

Developing Exchanges

Developing successful exchanges involves an important "getting to know you" phase. Academic programs have to be somewhat compatible to sustain exchange experiences. Some differences are good, because they give the exchange students options not available at their home institution. However, the basic educational philosophy needs to be compatible. Differences in program size may have some effect, but are generally not critical so long as the general respect and attention shown students are similar

It is best to sign some sort of mutual exchange agreement. Most agreements will be amended over the years, and will eventually be pretty much forgotten. However, they provide an initial statement of expectations and responsibilities on both ends. Agreements should also have a fixed life, usually three to five years. This provides an out for either institution should the exchange prove to be one sided or not mutually beneficial.

After the programs know each other, and the formal agreements are signed, it is time to implement the exchange. This involves selling the program to the students, convincing them that it is in their best interest to leave their home institution and travel abroad to attend classes at the international partner for a semester or a year. Careful selection of exchange partners in the first place, and careful preparation of students with respect to language proficiency and the need for a global perspective in engineers should make the task easier. Union students have the extra incentive that they are required to have some sort of international experience.

Support Services

Generally, but not always, students on exchange programs will have a smaller peer support group than students on regular terms abroad Also, faculty from the home institution seldom accompany exchange groups. The exchangees may be attending classes where they know no one, are coping with understanding lectures in a language other than English, and everyone else knows each other.

Therefore, adequate support services before and during the exchange are important if students are to cope with these new challenges and achieve the maximum benefit from their experience. Prior to traveling students need guidance, and sometimes assistance, in obtaining the necessary visas, passports, airline tickets, and any other required travel documents. Housing at the exchange university should already have been reserved for them, and they should receive details on what will happen when they arrive. Either before the leave home, or immediately after their arrival, they need to be given a cultural orientation on what to expect and how they should act. It may be possible to use the Internet for this orientation.

It is important that the international office at the host institution continue to provide support services throughout the exchange stay. Social and recreational opportunities should be provided. Continued contact after the exchange can be useful for follow up, assessment, and continued collaboration.

OBSTACLES TO BE OVERCOME FOR SUCCESSFUL INTERNSHIPS AND EXCHANGES

Exchanges and internships are hard to nurture if there are not primary contacts at each end who know and work well with each other. For exchanges, an adequate student support office is also critically important. For internships, the employer should provide assistance in finding housing. Exchanges and internship programs should be institutionalized so they are not dependent on one person to keep them going. Other possible obstacles include language barriers, schedule differences, academic credit evaluation, sustainability, visa requirements, and international currency fluctuations.

Language Barriers

U.S. engineers are at a competitive disadvantage if they are not proficient in a second language. Almost all graduating engineers in Europe, Asia, and Latin America are proficient in at least two languages, usually their native language and English. Many are proficient in three or more. At a recent workshop on international engineering internships, German engineers stated that the expectation in German industry is that entry level engineers be tri-lingual [4].

Engineering exchanges and internships are an excellent way for students to increase their language proficiency. However, they need to be functional in the language of the host country before traveling abroad. Unfortunately, U.S. secondary schools do not give language instruction a high priority. In a recent study, only 33.6% of the incoming freshmen engineers at Union had four or more years of language instruction in high school (23.0% Spanish, 6.2% French, 2.2% German, and 2.2% other). A full 14.6% had no language background, and the remaining 51.8% had between one and three years of instruction (Jewell 2003). There is no requirement for engineering students at Union to take languages, but some do because they are interested in them, or want to take a term abroad that has language proficiency requirements. We are doing everything we can to encourage the taking of languages, starting with advising during freshman orientation.

Schedule Differences

As can be seen in Figure 1, conflicts can easily arise in trying to schedule term or semester exchanges without impinging on the next term or semester at the home school.

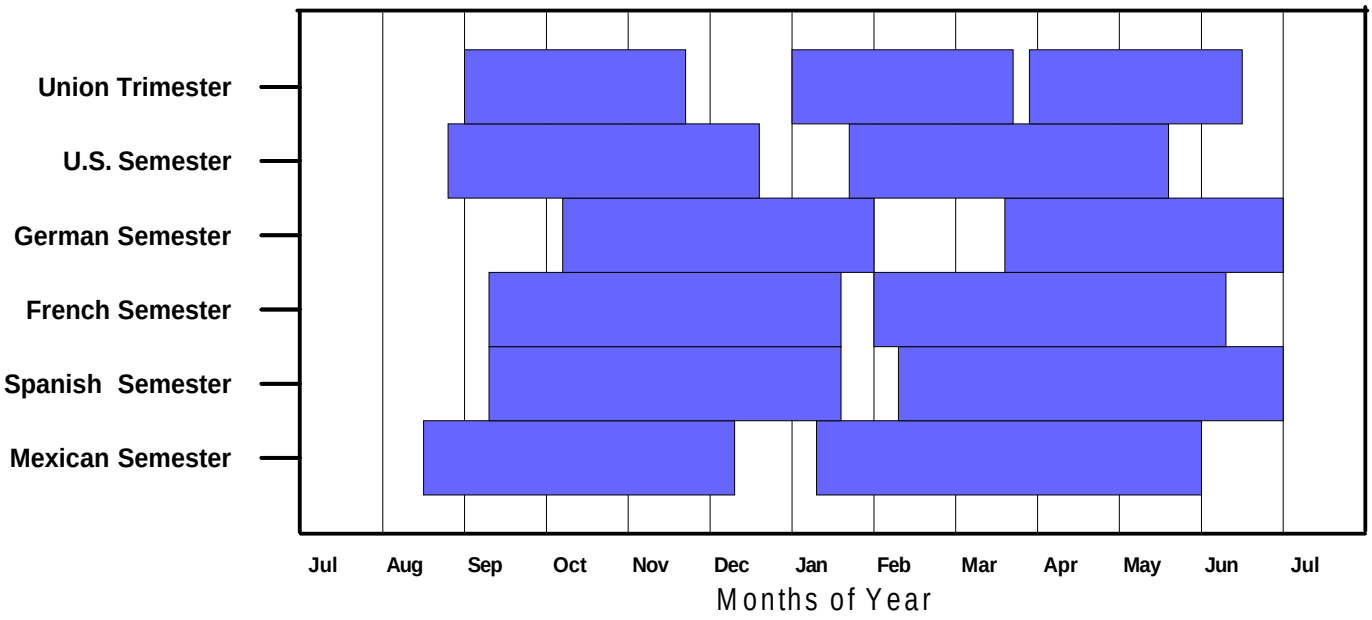

FIGURE 1
COMPARATIVE ACADEMIC CALENDARS

Union ends up having a preponderance of its exchanges during our fall term. Even at that, exchanges with German, French, or Spanish schools have to be truncated before their normal completion so students can get back to Union for the start of the winter term. Internships are more flexible in scheduling.

Miscellaneous Obstacles

Academic credit evaluation can be a problem with exchanges. Europe now has the European Credit Transfer System which aims at standardizing credits and simplifying transfer credits from one country to another. However, the system does not address differences in rigor or content of courses. Also, no similar standards exist between European and U.S. universities. U.S. engineering programs have the added concern of documenting outcomes required to meet Accreditation Board for Engineering and Technology, ABET, criteria. The best way to overcome this obstacle is to have faculty in each discipline examine and approve courses the students will take at the international location, and to keep thorough documentation concerning the course content and outcomes. This will have the added advantage of getting faculty to buy into the whole exchange concept.

It may be difficult to sustain exchanges over the long haul, especially if the number of students going between the partners is unbalanced in the same direction for several years. It is generally acceptable for the numbers to vary from one year to the next, so long as the aggregate numbers balance out over a three to five year period, or whatever is specified in the agreement. It is best not to develop exchanges in the first place that students are not going to have interest in. Once you get a few students to go on an interesting exchange, word of mouth will be a powerful tool to encourage students to apply for subsequent offerings. For exchanges to endure, they have to be a win/win situation for both institutions.

Visas are not so much an obstacle as a time consuming necessity when required by the host country. Student support services on either, or both ends of the exchange should help students acquire, fill out, and submit the necessary paperwork. And finally, international currency exchange rate fluctuations are something none of us has much control over, but they can play havoc with a student's cost of living projections. Whenever possible, rates for housing or other advance payments should be quoted in the currency of the home country. That way the student knows the amount to budget.

CLOSURE

Academic exchange programs can be extremely valuable experiences for engineering students in their efforts to understand the globalization of engineering practice. Not only will they become familiar with another culture, but they will also become familiar with how engineers function in that culture. Exchanges have the added benefit of bringing international engineering students to the Union College campus where they can interact with both our engineering and liberal arts students. Even

though there may be some costs involved in developing and maintaining exchange programs, the benefits to the institution and the students far outweigh the costs.

REFERENCES

[1] T. Jewell, "Gaining Global Perspective through Terms Abroad," *Proceedings* , 2003 Annual Conference and Exposition, American Society for Engineering Education, Nashville, TN, June 20-25, Session 2793.

[2] T. Jewell and W. Thomas, "Benefit/Cost Analysis for International Study Options," *Proceedings* , International Symposium on Technology and Society, ISTAS 2004, WPI, Worcester, MA, June 17-19.

[3] E. Doerry, K. Doerry, and B. Bero, "The Global Engineering College: Exploring a New Model for Engineering Education in a Global Economy," *Proceedings* , 2003 Annual Conference and Exposition, American Society for Engineering Education, Nashville, TN, June 20-25, Session 2360.

[4] J. Melsa, D. Holger, and L. Zachary, "Achieving a Global Academic Industrial Network for Students and Faculty," *Proceedings* , 2003 Annual Conference and Exposition, American Society for Engineering Education, Nashville, TN, June 20-25.

[5] T. Jewell and W. Thomas, "Exchange Programs as a Means of Increasing Engineering Students' International Study Options," *Proceedings* , International Conference on Engineering Education and Research, iCEER 2004, Olomouc, Czech Republic, June 27-30.